

The Earth Science

DIGEST



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THE EARTH SCIENCE INSTITUTE

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New Mexico Coal Resources Exceed 61 Billion Tons

WASHINGTON, Jan. 19 — The coal resources of New Mexico recently have been appraised by the U. S. Geological Survey, and estimated at more than 61 billion tons. Of this large total more than 50 billion tons is sub-bituminous coal, located for the most part in the San Juan Basin in northwestern New Mexico. Most of the remainder is bituminous coal, concentrated largely in the Raton Mesa field in Colfax County. Some of the bituminous coal in Colfax County possesses coking properties, which makes it of particular interest in view of the scarcity of coking coal in the western states. Seven other smaller fields are included in the appraisal.

During the course of the Geological Survey's study, which was undertaken as part of a program to re-estimate the coal resources of the United States, all available information from operating mines, exploratory wells, and existing maps and reports of the Geological Survey were used. As large parts of the New Mexico coal fields are relatively unexplored, however, the total appraisal is regarded as tentative and subject to modification as new information is acquired.

A detailed report on the results of the appraisal now in preparation by the Geological Survey shows more than 50 billion tons of sub-bituminous coal in beds more than 30 inches thick, and nearly 11 billion tons of bituminous coal and small amounts of anthracite in beds more than 14 inches thick, all under less than 3,000 feet of overburden.

A preliminary table showing the summary results of the appraisal has been prepared by the Geological Survey. The reserves are

classified according to coal field, county, and geological formation in which the coal occurs and are divided into four categories according to the reliability of the information on which the appraisal was based. Pending completion of the Geological Survey's detailed report on New Mexico coal resources, this table is now available for use by those interested in the development of the State's coal resources. Copies of the table, titled "Estimated original coal reserves in New Mexico," may be obtained without cost upon application to the Director, U. S. Geological Survey, Washington 25, D. C.

Meetings and Conventions

- Earth Science Institute, Annual Meeting, March 17, 1950. Boston University, Boston.
- Conference on the Teaching of the Earth Sciences in the Secondary Schools, March 17-18, 1950. Boston University, Boston.
- National Speleological Society, National Convention, March 31 - April 2, 1950. Dodge Hotel, Washington, D. C.
- Seismological Society of America, Annual Meeting; Cordilleran Section of the Geological Society of America, Annual Meeting, April 7-8, 1950. University of Washington, Seattle, Washington.
- American Association of Petroleum Geologists, 34th Annual Meeting; Society of Economic Paleontologists and Mineralogists, 23rd Annual Meeting; Society of Exploration Geophysicists, 19th Annual Meeting, April 23-28, 1950. Chicago.
- California Federation of Mineralogical Societies, 11th Annual Convention, June 17-18, 1950. Trona, California.
- American Federation of Mineralogical Societies, 3rd Annual National Convention; Midwest Federation of Geological Societies, 10th Annual Convention, June 28-30, 1950. Milwaukee, Wisconsin.

INVESTIGATION OF THE PRAIRIE CREEK DIAMOND AREA, PIKE COUNTY, ARK.❖

J. R. Thoenen, Robert S. Hill, E. G. Howe, and S. M. Runke

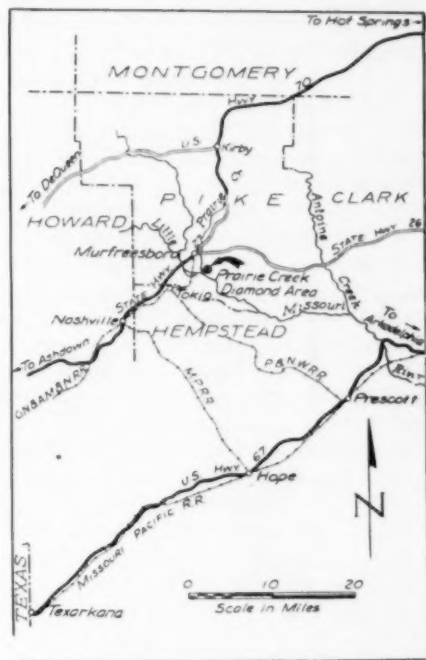
United States Bureau of Mines

INTRODUCTION

The war imposed a terrific demand for industrial diamonds upon a market already having difficulty in supplying the growing peacetime demand. As a result, the grade or size of the industrial stones decreased with increased consumption. This war-stimulated demand created interest in the possibility of supplementing imports by domestic production.

It was known that Pike County, Arkansas, contained a peridotite pipe similar to the pipes of South Africa that had produced so many diamonds in the past. The area had aroused considerable interest since its discovery, and available information indicated that some 50,000 stones had been recovered, of which about 90 per cent were considered to be good-quality industrial grade.

The North American Diamond Corp. controlled the site of the largest operation and sought to obtain priorities from the War Production Board to erect a large plant and operate the property. The Board, after considerable study and investigation, decided the evidence did not warrant immediate erection of a large plant



U. S. Bureau of Mines
Index map of the Prairie Creek
diamond area.

but that further tests to determine the possibility of economic recovery were desirable.

A preliminary examination of the Prairie Creek area was undertaken by the Bureau of Mines. Two stones were recovered from this test, and a larger and more detailed examination and sampling program was instigated. This re-

*Reprinted in part from Bureau of Mines Report of Investigations 4594 (November 1949).

port describes the work done by the Bureau during both preliminary and final tests and the results obtained.

HISTORY

A comprehensive history of man's search for the diamond would fill many volumes. For the purpose of this report, it is sufficient to note that the search dates back to antiquity, as Bate-man indicates diamondiferous deposits were worked in India as far back as 800 B. C. and that they were used for decorative purposes (gems) as early as 840 B.C. (1)*

Prior to the discovery of the volcanic pipes of South Africa in 1870, all diamonds were obtained from placer deposits. World production centered in India until the second decade of the 18th century, when Brazil became the principal source of diamonds. Brazil, in turn, gave place to South Africa in the latter half of the 19th century. In the 20th century, the principal source remained in Africa but switched from the volcanic pipes to some remarkable placer deposits discovered in Central Africa in 1907.

Isolated diamonds were found in the United States, beginning in 1832 in Indiana. In 1842 they were discovered in Arkansas, and since then they have been found in various other States. However, all these isolated finds were ascribed to transportation by glaciers from northern Labrador and subsequent alluviation. No diamonds were found *in situ* outside of South Africa until John W. Huddleston picked up one on his farm in the Prairie Creek area of Pike County, Arkansas, on the morning of Aug.

1, 1906. Later in the same day he found a second stone (3). The presence of a small igneous area near Murfreesboro, Arkansas, was known to geologists as early as 1842, although it was not mapped until 1889 by Branner and Brackett (2). In their report, Branner and Brackett rather cautiously suggested the possibility of diamonds in connection with this occurrence. It remained for Huddleston, however, to find the first stone 16 years later.

Shortly thereafter some stones were sent to Chas. S. Stiff, a jeweler in Little Rock, who sent them to Dr. G. F. Kunz of New York, who identified them as diamonds of good quality. Stiff then organized a syndicate and obtained an option on the Huddleston farm. Dr. Kunz and Henry S. Washington examined and reported satisfactorily on the property for the syndicate (5, 6). The syndicate then organized the Arkansas Diamond Co. and took up the option.

This initial start stimulated exploration, and the Mauney and Ozark mines were opened just north of the Arkansas but on the same peridotite plug. Later, two more plugs were discovered about two and a half miles northeast of the Prairie Creek area; on these, the Kimberlite and American mines were opened. Some prospecting was done on property of the Grayson-McCloud Lumber Co., known as the Black Lick, south of the American mine, but there is no record of discovery there.

In the initial operations (1909), four companies and two private holdings were active: Arkansas Diamond Co., Ozark Diamond Mines Corp., American Diamond Mines Co., Kimberlite Diamond Mining & Washing Co., M. M. Mauney, and Grayson & McCloud Lumber Co.

*Figures in parenthesis refer to items in the bibliography.

No diamonds were recorded as coming from the property (Black Lick) of the Grayson & McCloud Lumber Co., but all the other operations did produce some stones. A good account of the early history of these workings is given by Fuller (3, 4).

The Arkansas Diamond Co. continued production from 1906 to 1932, when activity ceased. In 1941, the property was acquired by the North American Diamond Corp.

The entire district is estimated to have produced some 50,000 diamonds, of which 80 percent are credited to the Arkansas mine. The remaining 20 percent came from the Mauney and Ozark mines, with only a few stones from the two plugs to the northeast, on which the Kimberlite and American companies operated.

About 90 percent of all stones produced were classified as industrial diamonds and the rest as of gem quality. The size of the individual stones ranged from very small (250 to the carat) to 40.25 carats. The average size of the stones was about one-quarter carat.

OCCURRENCE

The deposit itself has the shape of a rough equilateral triangle with well-rounded corners. The diameter is approximately 1,800 feet, and the depth is unknown. It covers an area of about 73 acres. However, nearly all of the past production has come from the weathered, brecciated peridotite on the east and south sides. The weathered portion of the pipe was the area investigated, and the area drilled covered 18.33 acres.

GEOLOGY

The Prairie Creek area comprises sediments ranging in age from Carboniferous to Quaternary

that have been intruded by an igneous mass during post-Trinity, Cretaceous time. The geology of this area has been mapped and described by Miser and Ross (7).

The oldest rocks exposed are sandstones and quartzites probably belonging to the Jackford sandstone of Pennsylvanian age. These rocks outcrop mainly on the southern and eastern flanks of the intrusive, but there is also an isolated occurrence on top of East Hill, the highest point in the area. The sedimentary rocks have been moved upward to their present location by the action of the intrusive.

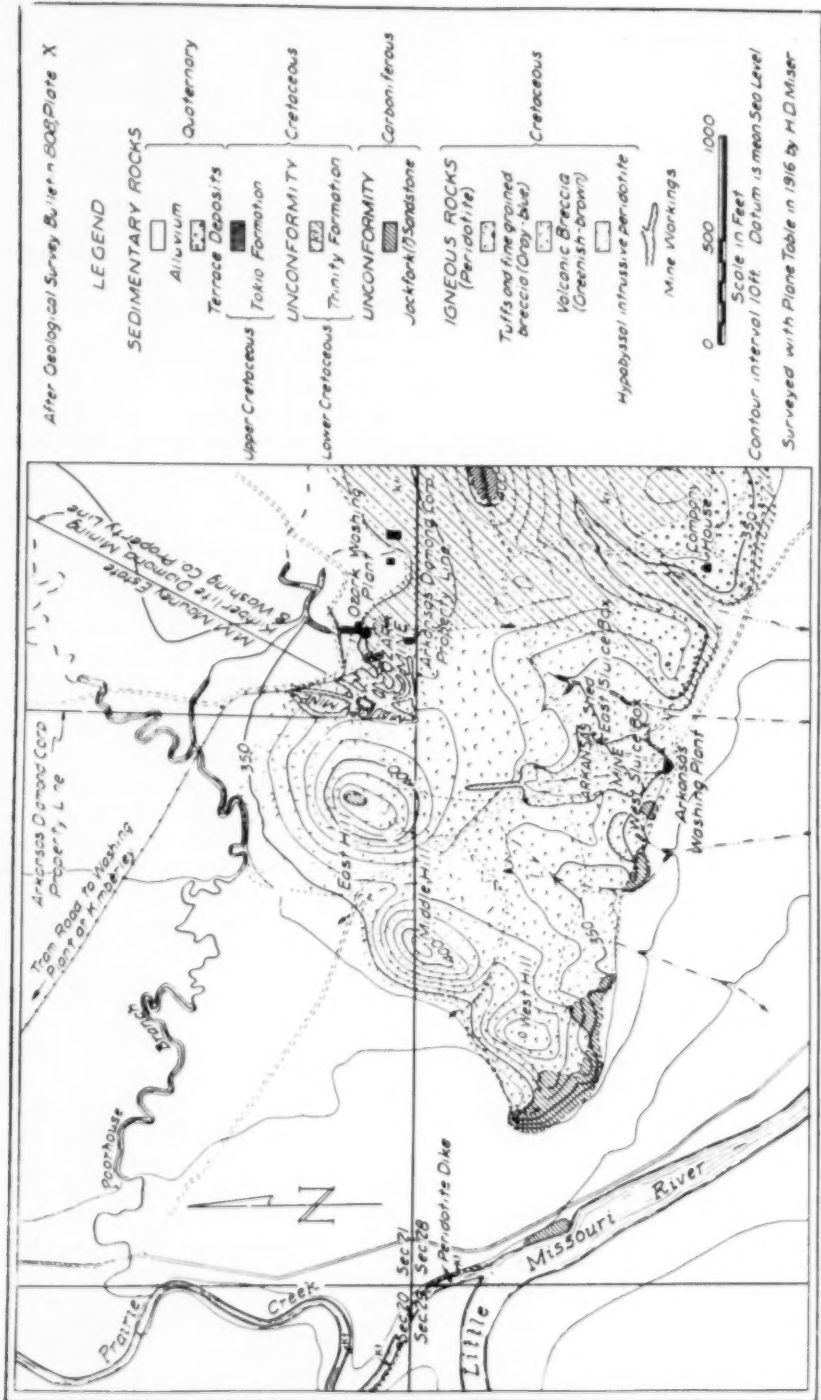
Unconformably overlying the Jackford sandstone in this immediate area are sandstones, sands, and shales of Lower and Upper Cretaceous age. These are exposed along the east flank of the igneous mass, the balance of which is covered by Quaternary sands and gravels. The Trinity formation of Lower Cretaceous age is in contact with the east side of the intrusive and has been intruded and metamorphosed by it. The Tokio formation of Upper Cretaceous overlies the Trinity a short distance farther east.

Terrace deposits of Quaternary age overlie the Trinity in the southeastern part. Covering the greater part of the area north, west and south of the intrusive, is alluvium composed of unassorted river sands and gravels.

The diamond-bearing igneous mass is composed of peridotite and genetically related intrusives and extrusives, mostly breccias and tuffs.

CHARACTER OF THE ROCKS AND MINERALS

Where it is still found in place, the original surface is black soil forming the so-called "black ground," the color resulting from



GEOLOGIC MAP OF THE PRAIRIE CREEK AREA.

U. S. Bureau of Mines

After Geological Survey Bulletin 808 Plate X

organic material. This black ground held a concentration of diamonds due to weathering (7).

Below the black ground lies the volcanic breccia that is the true Kimberlite of South Africa, consisting of fragments of peridotite and relatively few fragments of shale and sandstone, largely altered to soft rock and clay at the surface. This forms the "yellow," "green" and "blue" ground. Below the breccia lies the unaltered peridotite named "hardebank" by the miners. Boulders of unaltered peridotite are included in the breccia also. There is only one reported instance of a diamond having been found in the peridotite matrix, namely, at the Arkansas mine in decomposed peridotite (5).

Most of the weathered, brecciated peridotite that occurs close to the surface can be broken readily, although occasional hard spots will be found. This brecciated material occurs in a roughly elliptical area covering about 28 acres on the east and south sides of the pipe. The old mine pit, covering roughly 15 acres, lies within this area.

Tuffs and injection breccias encountered in one of the early diamond-drill holes drilled to a depth of 205 feet showed weathering to the bottom (1, 7). This zone of weathering or oxidation becomes of great importance with increasing depth in mining diamonds. The soft surface material breaks down easily and permits direct treatment of the diamond-bearing substance in the concentration plant. From evidence obtained, it is believed that material 20 to 40 feet below the surface can be so treated directly. Below this point the material mined probably will have to be either crushed or "floored." "To floor" is a term used in diamond mining and refers to the process

of spreading hard material in thin layers on open-air platforms or floors, where it disintegrates by normal weathering. This is preferable to crushing, which may inadvertently break some of the included diamonds.

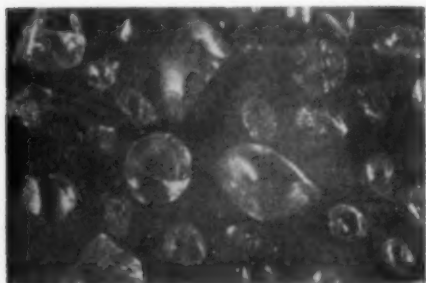
The first 140 diamonds found were examined and described by Kunz (5). The diamonds occur mostly in the form of distorted hexoctahedrons, which are most frequently elongated but occasionally flattened. The faces are always well-rounded. There are also regular undistorted octahedrons showing slightly rounded faces, whose edges are often modified by other forms. Some of the diamonds show indentations, and about half are fractured.

The color ranges from clear white through yellow and brown to mahogany. Some of the stones are gray, and a number are almost black. The Arkansas diamonds are reported to be extremely hard (4, 7).

The petrography of the rocks in this area has been described by Ross and Mitchell (7). Associated with the breccia and found as concentrates when washed for diamonds are iron minerals, barite, quartz, various garnets, and other minerals in decreasing order of importance. The tuffs and fine-grained injection breccias are composed essentially of chlorite with phlogopite and serpentine. The color is light blue. No diamonds have been reported found in them.

SAMPLING

The diamonds previously mined were scattered indiscriminately throughout the brecciated area without regularity either horizontally or vertically. The greatest concentration of diamonds appears to have been found in the black ground capping the brecciated



U. S. Bureau of Mines

Diamonds recovered (magnified 2.8 times)

peridotite. This averaged about 2.5 feet in thickness and yielded a diamond concentration of approximately 0.844 carat per cubic yard. Most of this black ground has been mined in previous operations.

The estimated yield of the underlying yellow, green, and blue ground, based on test runs made at the Mauney and Ozark mines, averaged 0.135 carat per cubic yard (7 to 9 carats per 100 loads*). Recovery from combined surface and subsurface material showed 0.177 carat per cubic yard (10.5 carats per 100 loads).

Experience in the South African fields showed that, because of similar dissemination, one part in 2,000 to 3,000 should be tested to reach a satisfactory figure representing the diamond content of a deposit of this type.

The samples washed totaled 435 tons and produced 21.389 tons of concentrate, an average ratio of reduction of 20.3 to 1. The total recovery of stones numbered 32 and weighed 1,686.0 mg. (8.4 carats).

Of the 49 holes considered, 38 furnished two or more samples

*The "load" is a unit of volume used in diamond mining and contains 16 cubic feet of material weighing, roughly, 1,600 pounds.

and 8 were drilled below 36 feet. Of the stones recovered, 73.3 per cent in number and 57.5 percent in weight came from 20 feet or less in depth; one weighing 40.70 mg. came from below 36 feet. The 32 stones averaged 52.7 mg., or 0.256 carat, in weight. Thus substantiates the reports of Fuller and Miser on the average size of the total stones mined from the Prairie Creek area.

Of the three appraisers to whom the stones were submitted, only one suggested that possibly the four largest stones might be of gem quality but not well-shaped for cutting. All, however, graded the entire lot as excellent industrial diamonds.

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Report on Beach Study in Massachusetts Released

WASHINGTON, Dec. 30 — A short "Preliminary study of beach erosion between Nantasket Beach and Duxbury Beach, Massachusetts," has been placed in open file by the Geological Survey.

Beaches between Nantasket and Duxbury were formed mostly as sand bars, spits, and bay-mouth bars, known also as "pocket beaches." They extend from or between promontories composed mostly of glacial till, although in a few of the promontories bedrock is exposed at and slightly above tide levels. Most of the beaches, therefore, are independent of each other, for sand and shingle composing them do not migrate to any appreciable extent beyond the controlling headlands. As a consequence individual

beaches present separate problems of control, dispersal, and accretion of beach materials. Evidence acquired so far, however, suggests that the shore line is receding slowly and that the beach materials are being eroded faster than they are being replenished. Suggestions are made for further detailed geologic studies of the shore line.

Copies of the report, including a geologic map of the shore line, may be inspected at the U. S. Geological Survey, Room G-234, and the Geological Survey Library, General Services Building, Washington, D. C.; and at the offices of the Massachusetts Department of Public Works, and the U. S. Geological Survey, 100 Nashua St., Boston, Mass.

EXTINCT SOUTH AMERICAN HORSE-LIKE ANIMAL WAS EVOLVED INDEPENDENTLY

NOTRE DAME, Ind., January 4 (Science Service) — A South American horse that looks like the horse we know today, yet was produced by independent evolution, is a striking example of nature's experiments in evolution on a vast scale.

That animals very similar to those of other continents are the result of "convergent evolution" was stated here today by Dr. George Gaylord Simpson of the American Museum of Natural History. He presented his theories concerning the evolution of South American animals to the Society of Sigma Xi, national society for the encouragement of scientific research.

Dr. Simpson suggested that animals migrated to South America before the land bridge between the two continents had been submerged. When the continent became isolated, the animals evolved either as unique specimens or as types very similar to those of other continents. As an example of the latter he noted the extinct horse-like litopterns and the horse.

When the land bridge between North and South America was established again, the South American animals that were similar to North American ones became extinct. Types of animals that were unique to South America, however, generally survived, Dr. Simpson stated.

U. S. COAST GUARD COUNTS ICEBERGS FROM AIR



Official U. S. Coast Guard Photo

Greenland's mountain ranges are "lost" beneath countless tons of glacial ice. This photo was taken during the "calving" season when city-block-size icebergs break off into the fiords.

The 1949 Aerial Iceberg Census conducted in the Baffin Bay region (Greenland) by the U. S. Coast Guard "counted" 40,232 icebergs.

This count is based on a photo-

graphic survey made by aerial cameras mounted in planes that flew over the area.

Counting icebergs is done to anticipate and forecast ice menace



Official U. S. Coast Guard Photo

Glaciers such as this one near Sondrestrom Fjord in Greenland, forced along by the pressure of the tremendous Greenland Ice Cap, move as much as fifty feet per day. They are responsible for the icebergs that drift into the North Atlantic.



Official U. S. Coast Guard Photo

Thousands of icebergs, recently "calved" from glaciers, assemble for the big drift toward the North Atlantic. Hundreds will disintegrate during the three-year-long "march" of almost 2,000 miles.

to North Atlantic shipping. The 1949 operation was the second conducted by the Coast Guard, the first being made in 1948.

Two planes (PB1G — converted B-17) from the Coast Guard Air Station, Elizabeth City, N. C. engaged in the operation, each plane carrying aerial cameras mounted in port (left) and starboard (right) plexiglass blisters installed in place of flat windows to permit maximum visual coverage. Five cameras were used during the entire survey.

Although Greenland is a land of glaciers, twenty located in West

Greenland are responsible for most of the icebergs that drift toward the Grand Banks. Hundreds of these disintegrate during the three-year-long drift of almost 2,000 miles but other hundreds do reach the North Atlantic, an area blanketed by fog from April to July through which passes the world's heaviest sea-borne traffic.

Icebergs cannot be destroyed by man or diverted from their course and no one doubts the claim of veteran "icemen" that, "The only sure sign of an iceberg is to see it."

Montana Sapphire and Abrasive Corundum Report Released

WASHINGTON, Dec. 8 — A report on Montana corundum including the Yogo sapphire deposit, one of the most productive gem deposits in the United States in the past, has been completed under the direction of the U. S. Geological Survey.

The study was made by S. E. Clabaugh, Survey field geologist, as part of the Department's program for the development of the Missouri River Basin.

From the Yogo deposit in Judith Basin County have come excellent cut sapphires valued at \$20,000,000 to \$30,000,000, mined chiefly by a British syndicate which suspended operations in 1929. The sapphires occur in an altered dike and in associated placers.

A few gem sapphires and large quantities of industrial stones for instrument bearings have also been recovered from placer operations along the Missouri River near Canyon Ferry northeast of Helena, from tributaries of Rock Creek southwest of Philipsburg, from Dry Cottonwood Creek southeast of

Deer Lodge, and elsewhere in the region.

Common corundum, suitable for abrasive use, occurs in several thin, lenticular beds or veins in metamorphic rocks of pre-Cambrian age in Gallatin and Madison Counties, southwest of Bozeman. These deposits were investigated by the U. S. Bureau of Mines and the Geological Survey as potential sources of abrasive material.

Mr. Clabaugh's report, entitled "Corundum Deposits of Montana," accompanied by large-scale maps of the Yogo sapphire deposit and the abrasive (industrial) corundum deposits in Gallatin and Madison Counties, has been approved for release by Dr. William E. Wrather, Director of the Survey. It will be placed in open file for public inspection at the offices of the Survey, Room 1033 (Library), General Service Building, Washington, D. C., and South 157 Howard Street, Spokane, Wash.; and at the office of the Director, State Bureau of Mines and Geology, Butte, Montana, and the Harvard University Library.

Earth Science Abstracts

[Selected articles on the earth sciences, appearing in current scientific publications, are abstracted here for the convenience of our readers.]

PETROLOGY

CLASSIFICATION OF SEDIMENTS.

Joseph M. Trefethen. *Am. Jour. Sci.*, Vol. 248, No. 1 (Jan. 1950), pp. 55-62. The author presents the grade scale tentatively in use by the Maine Geological Survey, and two new sediment classification triangles for unconsolidated mixtures of sand, silt, and clay grades, and for consolidated sediments.



LOESS, AN EOLIAN PRODUCT. D. J. Doeglas. *Jour. Sed. Petrology*, Vol. 19, No. 3 (Dec. 1949), pp. 112-117. Evidence based on the petrographic characteristics and field relationships of loess deposits in Holland and the Mississippi Valley points to its eolian origin rather than being a water-laid product.



RADIUM CONTENT OF ULTRAMAFIC IGNEOUS ROCKS: II: Geological & Chemical Implications. G. L. Davis and H. H. Hess. *Am. Jour. Sci.*, Vol. 247, No. 12 (Dec. 1949), pp. 856-882. The relationship of decreasing radium (and uranium) content with increasing mafic (ferromagnesian and other non-felsic minerals) character of rocks is demonstrated. The probable redistribution of uranium during partial melting, crystallization, and alteration, and the causes of contamination are discussed. The appendix contains petrographic descriptions of rocks.



SANDSTONE TYPES: THEIR ABUNDANCE AND CEMENTING AGENTS. Sefton L. Tallman. *Jour. Geology*, Vol.

57, No. 6 (Nov. 1949), pp. 582-591. The sandstones are classified into five general classes: orthoquartzites (relative abundance about 45%); feldspathic sandstones (7%); arkoses (10%); subgraywackes (21+); and graywackes (17%). There is a definite increase in carbonate cements in the later geologic periods. In almost all sandstone specimens there was a partial replacement of the detrital grains.

ECONOMIC GEOLOGY

GEOCHEMICAL PROSPECTING FOR ORES: A PROGRESS REPORT. H. E. Hawkes. *Economic Geology*, Vol. 44, No. 8 (Dec. 1949), pp. 706-712. The current methods of prospecting for ores by means of chemical studies of residual soil, alluvium, glacial moraine, vegetation, and natural water are reviewed.



PROSPECT — ORE. *Monsanto Magazine*, Vol. 28, No. 5 (Dec. 1949), pp. 8-11. A popular account of the phosphate deposits of Maury Co., Tennessee. These deposits were laid down during the Ordovician period, about 130 million years ago, and are associated with the Bigby limestone, characterized by *Cyclora Minuta*, a small ram's-horn-shaped snail shell.



THE PROBLEMS OF COAL GEOCHEMISTRY. Horace P. Miller. *Economic Geology*, Vol. 44, No. 8 (Dec. 1949), pp. 649-662. Research work in this field is briefly sketched with emphasis on the

work being done in the United States on the chemical constitution of coal, the chemical aspects of coal formation, and the physical properties of coal.

SUBMARINE GEOLOGY

SEDIMENTARY FACIES IN GULF COAST. S. W. Lowman. *Am. Assoc. Petroleum Geologists Bull.*, Vol. 33, No. 12 (Dec. 1949), pp. 1939-1997. A review is given of the biological and lithological aspects of sedimentary facies in the Gulf Coast. The author describes the principal results of investigations of Recent foraminifera in the bottom sediments of the Gulf of Mexico and the general methods of application of these results to older rocks.



SUBMARINE GEOLOGY AND STRATIGRAPHY. Francis P. Shepard. *World Oil*, Vol. 129, No. 9 (December 1949), pp. 72-77. Outward gradation, continental shelves, wave-built terraces, criteria for distinguishing deep and shallow water formations, submarine slumping, and the instability of supposedly stable coasts are discussed.

MISCELLANEOUS

GEOLOGY IN TENTH CENTURY ARABIC LITERATURE. Rushdi Said. *Am. Jour. Sci.*, Vol. 248, No. 1 (Jan. 1950), pp. 63-66. The Discourse of the Brothers of Purity contains some remarkably modern geological ideas, including a metamorphic cycle and the earliest known mention of peneplanation, pond evolution, epicontinental seas, weathering, and erosion and transportation by streams and the wind.



RECENT RESULTS OF INVESTIGATIONS ON THE FELDSPARS. Alexander Kohler. *Jour. Geology*, Vol. 57, No. 6 (Nov. 1949), pp. 592-599. Certain optical properties are dependent upon the thermal history of feldspar. The rela-

tion of crystal habits and optical properties of the potash feldspars to their genesis is presented.



VALLEY WIDENING PROCESSES IN THE COLORADO ROCKIES. Benjamin A. Tator. *Geol. Soc. America Bull.*, Vol. 60, No. 11 (Nov. 1949), pp. 1771-1784. Small, flat-floored basins usually associated with tributary drainage junctions result from the widening. The valley sides have retreated by weathering and local corrasion by streams; and the channels have shifted by plugging the main channel at the basin head and by tributary deposition on the basin floor. It is believed that the prominent piedmont flats in this region are caused by these valley widening processes.

WATER RESOURCES IN DECEMBER

The serious New York City water supply situation was not alleviated during December. A great increase in water use during recent years combined with a moderate drought to produce a severe shortage in the Nation's largest city.

Deficient stream flow persisted in the coastal region from Massachusetts to New Jersey, and ground-water levels on eastern Long Island continued to decline.

Stream flow increased generally over a broad area from the Maritime Provinces through New England to the Great Lakes region. Some areas of below-normal runoff persisted, but excessive runoff was widespread in other areas as a result of moderate rains and high temperatures that produced some snow melt.

In the West, stream flow was mostly near or below normal. Storage reserves are generally satisfactory except in Nevada.

— Water Resources Review

Earth Science Papers Presented at the A. A. A. S. Meeting

[The following abstracts were selected from the papers presented at the joint meeting of the American Association for the Advancement of Science (Section E) with the Geological Society of America held at the 116th Meeting of the Association, Dec. 29-30, 1949, at New York, N. Y.]

GLACIAL MOLDING OF THE GULF OF MAINE

GEORGE H. CHADWICK
Catskill, New York

One beneficial result of war was the invention of instruments for rapid surveying of underwater topography by supersonic echoes, and the actual charting of large areas in such detail as to make them as intelligible to the physiographer as is the surface of the land. Thus the contouring of a third of the floor of the Gulf of Maine, lying between Cape Cod and Nova Scotia, by Harold W. Murray (of the Coast and Geodetic Survey), exhibited at the meeting, answers the lament of George F. Wright (Ice Age, 1920, page 137): "Off the coast of Maine the ice... extended into the sea... leaving its terminal deposits in water so deep that there is little hope of ever determining its exact situation." Combining Murray's charts with these by Shepard and by Stetson of George's Bank, the shoal that sunders the depth of this Gulf from those of the open Atlantic, one concludes that the ice flow performed an unparalleled feat within the basin by fishhooking back upon

itself in an enormous eddy. The principal bottom current moved coastwise out of the Bay of Fundy, circling past Boston and Cape Cod to return northeastward to Nova Scotia against the steep north face of the Bank, dwindling meanwhile by melting to nothing and leaving its remaining load behind Brown's Bank, next beyond George's. At its hayday the ice spilled over and planted its moraine atop both Banks while its waters of melting channeled the oceanward slope of George's Banks.

The death record is even more striking. Five or six minor moraines on the Gulf's floor show that in warmer days, as supply weakened, ice-flow ceased, the mass in the basin stagnated and slowly shrank away from its walls, retaining the same outline in diminuendo, but with occasional pauses (probably slight spreading readvances as marginal melting increased the surface slope), comparable in size and spacing to the recessional festoons in Ohio.

NATURAL LIMESTONE WALLS OF OKINAWA*

DELOS E. FLINT
U. S. Geological Survey

Many natural walls of dense, secondarily cemented, cavernous limestone occur on the island of Okinawa as structures resembling natural levees along the banks of streams, as linear ridges along

the upthrown edges of fault blocks, as circular walls around old sink holes, and as ridges along the seaward edges of some limestone terraces. In one locality a zone of pinnacles is interpreted as the remnant of formerly continuous walls. These features have been developed in porous, permeable, very poorly cemented, fragmental limestones of the type common in limestone islands of the Pacific. Extensive deposits of residual clay or sandy clay blanket the limestone in the vicinity of the walls.

The author and his associates who worked on Okinawa believe these walls have been formed by secondary cementation of nearly vertical exposures of limestone, followed by differential solution which brought the denser, cemented parts into high relief. The secondary cementation progresses from the surface inward, similar to the "case-hardening" process by which cut blocks of soft limestone harden. Development of a soil cover prevents case hardening in areas removed from steep exposures. Growth of vegetation furnishes organic acids that aid in dissolving the limestone.

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PETROLOGY OF LOWER ORDOVICIAN CHERTS IN CENTRAL PENNSYLVANIA

ROBERT L. FOLK
Pennsylvania State College

Chert (or flint) is a common rock associated with Pennsylvania limestones. This paper attacks two problems concerning chert: (1) its mineral composition, and (2) its origin. The traditional view has been that chert is composed of a mineral "chalcedony" which

is closely related to but not identical with the very common mineral quartz. One of the major reasons for distinguishing the two as separate minerals has been the apparent difference in refractive index (speed of light through the substance). This study shows that the refractive indices are fundamentally the same, however, that of chalcedony being lowered because of the presence of abundant liquid-filled bubbles, less than 1/100,000th of an inch in diameter. Thus it is concluded that "chalcedony" is merely fine-grained quartz filled with bubbles, and there is no justification for considering it to be a different mineral.

The origin of chert has been a subject of considerable geologic interest, because it is often used in showing that distant rock formations are of equivalent age. These investigations show that chert grew on the sea-floor while but slightly buried in an unconsolidated lime ooze, long before the rocks were solidified and uplifted. The chert grew by replacing the surrounding ooze, preserving all the fossils and other delicate structures in much the same way as petrified wood is produced.

RAMPARTS ON THE ELEVATED ATOLL OF KITA DAITO JIMA*

RAYMOND A. SAPLIS
and DELOS E. FLINT
U. S. Geological Survey

Kita Daito Jima appears to be an excellent example of a well-preserved elevated atoll. A central depression, about one mile in diameter, is completely surrounded by a rim that ranges in width from half a mile on the southwest to 1¼ miles on the northeast. The rim is highest adjacent to the central depression, and seaward becomes

lower in a series of terrace levels. A well-developed natural limestone wall occurs along the inner edge of the rim, and remnants of walls occur on the outer edges of the terraces. Similar walls on the limestone terraces of other islands in the Pacific have been ascribed to solution, and some writers believe that they may be a factor in determining the differential uplift of an island. The walls of Kita Daito Jima are believed to have been formed by the secondary cementation of poorly consolidated reef limestones on sea cliffs and the subsequent more rapid solution of the poorly consolidated limestone adjacent to the well-cemented walls. Tilting does not appear to have been a factor in the formation of the walls on Kita Daito Jima.

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SPONTANEOUS GROWTH OF RADIALLY CONSTRUCTED CRYSTAL AGGREGATES FROM SUPERCOOLED MELTS

[A New Hypothesis Regarding Origin of
the Moon's Surface Features]

KARL H. ENGEL
West Englewood, N. J.

Radial structures of essentially two-dimensional symmetry emerged from shallow melts of suitable organic substances each of which followed consistently recognizable aggregational habits.

Simplest and most common is the horizontal segment of a radiating star, initiated either at the bottom or in the surface of the liquid. Growth proceeds most commonly with the original liquid. Occasionally, the structure may

rise above the surface through liquid creep and by normal extension of crystal growth. The star may become a hemispheric dome or cone.

Unusual developments were displayed by a few substances. They grew normally below the surface. On emergence, crystals sprouted spontaneously in rapidly growing bundles, forming fibrous tufts or complexly woven tubules. These were the new intermediate units of radial shields, pitted mounds, or cuplike structure capable of attaining appreciable size.

A surprising structure emerged from one substance when modified by traces of common organic solvents. Solidification began normally, generally with a submerged cone. Minute detached crystals formed in a liquid mantle surrounding the cone. At a given stage these were swept away by surface convection currents until arrested in a circular halo. The halo served as the start of a new growth that competed against the parent structure and later drew substance outside its rim. Depending on conditions, a great variety of annular growths bore unmistakable structural resemblance to the different types of lunar features ranging from the tiniest mounds and craters to the large maria.

Aggregational habits observable on a scale of 10 to 50 centimeters were repeated with remarkable fidelity in droplets a few millimeters across. Conceivably the same habits, somewhat coarsened, may be preserved on a very large or even planetary scale.

The many formal parallels provided by experimental relief structures support a hypothesis that the surface features of the moon originated through solidification of a relatively shallow layer of supercooled magma.

SYNTHESIS OF PIEZO-ELECTRIC MINERALS FOR FREQUENCY CONTROL

HUGH H. WAESCHE

Signal Corps Engineering Laboratories,
Fort Monmouth, N. J.

A program for piezoelectric (electricity produced by pressure) crystal synthesis was initiated by the Signal Corps at the close of World War II because world reserves of natural, radio-grade quartz crystals had been depleted by war-time demand while no new sources had been discovered. Previously, during 1944 and 1945 it had been suggested that the possibility of synthesizing quartz crystals be explored to offset the lack of this strategic material. Interest in the problem was spurred further by the discovery after V.E. Day, that the Germans had developed what was believed to be a successful hydrothermal method for synthesizing quartz crystals.

By the end of 1946 the Signal Corps had two quartz synthesis contracts in effect. In addition, Naval Research Laboratories and one private organization were making independent investigations in this field; all except the former were attempting to use the German hydrothermal method, which depended on the difference in solubility of vitreous and crystalline silica. Although early efforts to synthesize quartz by the American groups with this system were disappointing, continued research resulted in considerable success with another hydrothermal method utilizing crystalline quartz as source and seed material. A Government-sponsored and an independent agency both contributed to the more successful method. Another Signal Corps-sponsored contractor had greatly improved the German process.

In addition to quartz, the Signal

Corps has sponsored successful synthesis of crystalline nepheline, aluminum phosphate (berlinite) and tourmaline. The investigations are continuing with quartz synthesis showing the greatest possibility of ultimate success in attaining all the desired goals with the least difficulty.

STRUCTURAL HISTORY OF THE HUDSON VALLEY

ROUSSEAU H. FLOWER

New York State Museum

Two opposing theories have been developed concerning the deposition of the rocks of the Hudson Valley; one that alternating belts of contemporaneous limestone and shale were deposited in place; the other that they were deposited in widely different areas, the shale then thrust on the limestone, and the whole pattern broken by later faults and folds.

On the basis of more precise stratigraphic correlation, the geological history is reconstructed in the basis of each of these theories. Deposition in place requires a most unconvincing pattern of events in terms of deposition, subsidence, alternating with elevation and nondeposition or erosion, mainly because shale and limestone belts are quite uniform within themselves, but contrast strongly with one another. Objections to the present overthrust theory are discussed, and a modified theory is presented in which some are eliminated. This requires an asymmetrical trough with limestone deposited on the shallow western portion, shales in the deeper eastern portion close to a land mass which supplied material for coarse sediments by periodic elevation and erosion. Thrusting at the close of the Ordovician moved the shales upon the limestones, accompanied and followed

by minor thrusts, folds and faults, and followed by regional metamorphism. Many objections to the overthrust hypothesis are theoretical and are opposed by much of the new evidence.

THE PHYSICAL FEATURES OF VERMONT

ELBRIDGE C. JACOBS
University of Vermont

The Green Mountains are the dominant physical feature and extend, north to south, from border to border. They are "mature" anticlinoria and synclinoria of schists, gneisses, quartzites, and other metamorphics, intruded by granite and basic rocks. The mountains are a great allochthon which has been thrust northward onto the Lowland, along the Mountain Border fault.

The eastern part of the Lowland, composed of Cambrian dolomites and slates, has in its turn, as a member of the allochthon, been thrust onto the Ordovician autochthon along the Champlain fault.

The Taconic Mountains occupy the southwest part of Vermont and are also allochthonous. They are made up of several ranges of predominantly slates and carbonate rocks, quite unlike the acid metamorphics to the east and west. The origin of the Taconic rocks is believed to lie far east of the Green Mountains.

Between the Taconic and Green Mountains is the Valley of Vermont, floored in Cambrian dolomite.

The Vermont Piedmont extends from the Green Mountains to the Connecticut River. It is a much dissected peneplain which is an extension of the New England peneplain, of Schooley age.

The Northeastern Highlands belong to the White Mountain uplift. The bedrock metamorphics are underlain by great granite batholiths. Vermont Mount Monadnock is a syenite stock. The region is largely a wilderness.

Vermont rivers belong to the Champlain-St. Lawrence, Hudson, and Connecticut systems. Most of the largest streams are superimposed and have cut their water gaps across the Green and Taconic mountains. Otter "Creek", the longest river in the State, is a subsequent stream.

Farmer Finds Geology Worth Cash Money

Boston, Dec. 9 — At least one Massachusetts farmer is satisfied that geology can turn up information having cash value.

The State of Massachusetts and the U. S. Geological Survey have had a cooperative geological mapping project under way for a number of years, seeking to cover the entire state and locating principal bedrock and surficial geological features. One Sunday afternoon when a geologist was anxious to finish studies of some particularly interesting glacial formations near Lowell, Mass., a fence-post mender accosted him and asked him what he was doing.

It was obvious that some sort of mapping operations were under way, since the geologist was working with a plane table and making very careful terrain measurements. He explained he was especially interested in the abundance of material that had been dropped in the vicinity by the great Pleistocene glaciation as it had melted back some 25,000 years ago.

"Yup", replied the farmer, "Had a profitable little gravel bank there

until it ran out. Sure wish I had more". "You have", the geologist replied, and showed him on the map he was correcting where there were three other locations as rich or richer in glacial-dropped gravel.

The astonished man thought a moment, asked a few more questions, and apparently satisfied he

reached for his wallet, pulled out a ten-spot and allowed the information "is worth cash money to me". But since such advice regarding one's own property is made available by the Survey to anyone taking the trouble to ask, the man pocketed his money back.

NOVEL MAPPING TECHNIQUE DISCLOSED

WASHINGTON, Jan. 13 — A new stereoplotting mechanism enabling better maps to be made at lower cost, using paired aerial photographs in a modern version of the old parlor stereoscope, has been placed on public exhibition at the Shoreham Hotel this week. This first public showing of the U. S. Geological Survey's unique "Twinplex Stereoplotting Instrument" before the 16th annual meeting of the American Society of Photogrammetry, disclosed a newly designed instrument that is expected to be not only more accurate than conventional apparatus now in use, but will enable cartographers to turn out precision maps using almost twice the ordinary working space on each pair of overlapping aerial photographs.

The Twinplex was designed by Russell K. Bean, and engineered and built by the research staff of the Survey's Topographic Mapping Division. Photogrammetry is the art and science of producing accurate maps from aerial photographs. A number of instruments have been developed in recent years, allowing mapmakers to build maps in the laboratory gaining their data almost entirely from air photos. This is considerably cheaper, often more accurate, and certainly much faster than the time-honored practice of sending

out field parties to accomplish the task through extensive on-the-site operations. Frequently such expeditions are impossible or impractical because of mountainous, swampy, timber-covered or otherwise inaccessible areas. This, according to Dr. William E. Wrather, Director of the Survey, is the first radically new instrument in the field of photogrammetry since the Kelsh Plotter, also a development of the Geological Survey, exhibited at the Society's annual meeting two years ago.

However, none of the previously developed instruments provided for using convergent, low-oblique photography (paired photographs made from low flying planes at an angle of 20 degrees with the vertical) although it has long been known that such photography is a potential means of securing economical and accurate maps.

The Survey's "Twinplex" is believed to accomplish this. The first requirement is a pair of aerial cameras mounted so that both are brought to a focus and take overlapping photographs of the ground below, the pair being oriented either along the direction of flight or at right angles to it. Developed and produced as photographic positives, the paired films are placed in projecting apparatus in the Twinplex and caused to throw an

enlarged picture on the paper-covered slate desk on which the photogrammetrist works. One of the stereopairs is projected in red light while the other shows blue. The cartographer, equipped with spectacles possessed of one blue and one red lens, sees the ground in relief or third dimension, more sharply delineated perhaps than he would if actually in a plane looking down on the terrain. Thus he is able to transfer his basic data — the roads, buildings, streams, lakes, orchards, fields, and even sketch in the contours showing relative land height, with a minimum of error or distortion.

The pilot model at the Photogrammetry Society exhibit section is so new the paint is hardly dry and it has had only cursory tests thus far, on areas already mapped.

Use of this type of photography was suggested by a German scientist, Otto von Gruber, in a book published abroad in 1925. But no practicable instrument specifically

designed for the purpose of precision mapping with such photographs has been developed heretofore. The circular track mount for coupled projectors, their stirrup arrangement, the overhead adjustments and the carrier and track design are all completely new ideas not to be found in the prior art.

The inventor is prepared to assign his rights in the Twinplex to the United States Government in accordance with the code of federal regulations, and the instrument is expected to prove useful in all countries whose governments have extensive mapping programs. It will be especially interesting to those having large undeveloped areas not yet covered by accurate maps or engaged in extensive military operations.

Great Britain, Canada, Australia, Union of South Africa, the USSR, Brazil and China are considered to be among the potential users of such an instrument.

THREE EARTHQUAKE IN LESS THAN DAY IN WESTERN HEMISPHERE

WASHINGTON, D. C., Dec. 25 (Science Service) — Three earthquakes in 21 hours have been reported from three widely separated places in the Western Hemisphere. All three were "fairly strong." It is a rarity when they occur so close in time and so widespread geographically.

The three occurred in the island of Puerto Rico, in southern Mexico, and southern Bolivia. Dec. 21-22). A fourth quake, unconfirmed by seismographs in this country, was reported from Paraguay.

This heightened earthquake activity comes close on the heels

of the violent quake on Dec. 17 in Tierra Del Fuego, at the southernmost tip of South America. This quake, the most violent ever recorded in that part of the world, was also the first from there ever recorded on United States seismographs.

Although the frequency and distribution of the quakes are unusual, seismologist L. M. Murphy of the U. S. Coast and Geodetic Survey is not alarmed. He says that sometimes earthquake activity is greater than at other times "and this just seems to be one of the active periods."

New Books

All books listed here are deposited in the Library of The Earth Science Institute and may be borrowed by the members. Books marked with an asterisk may be purchased through The Earth Science Publishing Co., Revere, Mass.

*EARTH WAVES.

L. Don Leet. 1950. 122 pp., 58 figs.; \$3.00. (Harvard Monographs in Applied Science, No. 2, Harvard University Press and John Wiley & Sons, New York). A technical summary of present knowledge on waves in the earth, their measurement, observed types, and transmission. Special reference is made to its applications in mineral prospecting, studying weather forms, measuring vibrations from dynamite blasts to determine their effects on buildings, and mapping geologic structures. The microseism and its measurements are treated in a separate chapter.

BIBLIOGRAPHY AND INDEX OF GEOLOGY EXCLUSIVE OF NORTH AMERICA.

Marie Siegrist and Eleanor Tatge. Vol. 13-1948. 1949. 386 pp.; \$3.25. (Geological Society of America, New York. This annotated bibliography includes literature received by the U. S. Geological Survey and the Library of Congress prior to February 15, 1949, and literature published before 1948, whose transmittal was held up during World War II.

ON THE SYSTEM FORMED BY POINTS REGULARLY DISTRIBUTED ON A PLANE OR IN SPACE.

M. A. Bravais. Translated by Amos J. Shaler. 1949. 122 pp., 42 figs.; \$3.90 (Memoir 1, Crystallographic Soc. of America,

William Parrish, Sec'y-Treas., c/o Philips Laboratories, Inc., Irvington-on-Hudson, N. Y.). This memoir originally appeared in the *Journal de l'Ecole, Polytechnique*, Cahier 33, Tome XIX, pp. 1-128, 1850. The 14 space-lattice types and the polar lattice ("reciprocal lattice") were presented for the first time in this classical work.

THE ELEPHANT AS THEY SAW IT.

Elisabeth L. Egenhoff. 1949. 128 pp., 66 figs.; \$0.75. (Centennial Supplement to the *California Journal of Mines and Geology* for October 1949, Calif. Division of Mines, Ferry Bldg., San Francisco 11, Calif.). A collection of contemporary pictures and statements on gold mining in California from the first rumor of the "golden island" in 1510 to the year 1860. Mining scenes are shown with reproductions of daguerreotypes, ambrotypes, and lithographs.

GEOLOGY OF THE COAST RANGES IMMEDIATELY NORTH OF THE SAN FRANCISCO BAY REGION, CALIF.

Charles E. Weaver. 1949. 242 pp., 14 pls., 2 figs.; \$6.50. (Memoir 35, Geological Society of America, New York). The geography, systematic geology, structure, and economic deposits of the area are described. The Santa Rosa, Sonoma, Mt. Vaca, Vacaville, Point Reyes, Petaluma, Mare Island, Carquinez, and Antioch quadrangles are covered in the report. Geologic maps of each quadrangle are included with the memoir.

THE COUNTIES OF CALIFORNIA — MINERAL RESOURCES AND MINERAL PRODUCTION DURING 1947.

Prepared under the direction of Olaf P. Jenkins. 1949. 198 pp., 12 pls., 1 fig.; \$1.25. (Bulletin 142, Calif. Division of Mines, Ferry Bldg, San Francisco 11,

Calif.). This report includes a summary of the mineral resources of each county, its general geologic features, and the significant activities during 1947.



DIVISION OF THE PENNSYLVANIAN SYSTEM IN KANSAS.

Raymond C. Moore. 1949. 204 pp., 37 figs.; \$0.25. (Bulletin 83, State Geological Survey of Kansas, Lawrence, Kansas). A summary of studies made in the northern midcontinent region bearing on the classification of rocks belonging to the Pennsylvanian System in Kansas. This report takes account of the work done since the publication of Bulletin 22 (Stratigraphic Classification of the Pennsylvania Rocks of Kansas) in 1936.



UPPERMOST CRETACEOUS & PALEOCENE FLORAS OF WESTERN ALBERTA.

W. A. Bell. 1949. 232 pp.; 67 pls.; \$1.00 (Geological Survey Bulletin No. 13, Geological Survey of Canada, Ottawa). Available paleobotanical evidence is presented for the correlation of uppermost Cretaceous and earliest Tertiary formations of western Alberta. The prevailing variations of leaf forms have been illustrated. Descriptions of the species and the plant-bearing formations or groups are given.



GEOLOGY OF GARRISON TOWNSHIP.

J. Slattery. 1949. 34 pp., 6 illus., 3 maps; free. (Annual Report, Vol. LVIII, Part IV, 1949, Ontario Dept. of Mines, Toronto).



MacALPINE CHANNEL MAP-AREA; NORTHWEST TERRITORIES.

M. Feniak. 1949. 16 pp., 1 map.; \$0.10. (Paper 49-19, Geological Survey of Canada, Ottawa).

BULLETIN ELEVEN

National Speleological Society. Nov. 1949. 76 pp., illus.; \$1.50. (National Speleological Society, 510 Star Bldg., Washington, D. C.). Among the articles in this Bulletin are: Origin of Caves by Ralph W. Stone; Some Unusual Formations in Skyline Caverns, Virginia by E. P. Henderson; Mineralogical Data in Speleological Work by William J. Foster; and A Stormwater Cavern in the Lost River Region of Orange County, Indiana by Clyde A. Malott.



GROUND-WATER CONDITIONS IN THE SMOKY HILL VALLEY IN SALINE, DICKINSON, AND GEARY COUNTIES, KANSAS.

Bruce F. Latta. 1949. 152 pp., 6 pls., 13 fig.; \$0.25. (Bulletin 84, State Geological Survey of Kansas, Lawrence, Kansas).



THE MINING INDUSTRY OF THE PROVINCE OF QUEBEC IN 1947.

1949. 94 pp., 2 figs.; free. (Quebec Dept. of Mines, Quebec).



GEOLOGICAL RECONNAISS. OF PERIBONCA RIVER FROM PASSE DENGEREUSE TO ONISTAGAN LAKE, ROBERVAL & CHICOUTIMI COUNTIES.

S. H. Ross. 1949. 20 pp., 8 pls., 4 maps; free. (Geological Report 39, Quebec Dept. of Mines, Quebec).



GEOLOGY OF PART OF THE SELKIRK MOUNTAINS IN THE VICINITY OF THE MAIN LINE OF THE CANADIAN PACIFIC RAILWAY, BRITISH COLUMBIA.

V. J. Okulitch. 1949. 26 pp., 4 pls., 4 figs.; \$0.25. (Geological Survey Bulletin No. 14, Geological Survey of Canada, Ottawa).

Chart Will Aid Search For Oil and Gas In California

WASHINGTON, Nov. 23 — A new chart showing the age and correlations of lower Tertiary rocks in the central part of the Great Valley of California has just been published by the U. S. Geological Survey.

These lower Tertiary rocks are along the west side of the Lower Sacramento and San Joaquin Valleys and at Marysville Buttes, north of the main oil-producing region of California. The rocks have been tested at many places by oil-company drilling and gas has been found in commercial quantities. The chart is the result of a detailed study of the larger invertebrate fossils from 30 stratigraphic sections, including both surface and subsurface data. The fossils serve as a means of correlating and reinterpreting the extent of the several Paleocene and Eocene rocks units, including the producing gas sands.

The chart, printed in two sheets, each measuring 41 by 52 inches, shows a series of 30 graphic sections, with a vertical scale of 200 feet = 1 inch. The location and names of fossils, as well as the commonly used microfossil zones described by other authors and the rock-unit names, are listed beside the columns. An alphabetical list of fossils, another list of fossils arranged according to age groups, a diagram showing frequency of occurrence and range of selected groups of fossils, an index map, and a text which discusses age, correlation of the formations, and their contained faunas accompany the columnar sections.

The chart, titled "Lower Tertiary stratigraphy of Mount Diablo, Marysville Buttes, and west border of lower central valley of California" by Ralph Stewart, has been issued as Preliminary Chart 34 of

the Oil and Gas Investigations series. Copies may be purchased from the Map Distribution Office, U. S. Geological Survey, Denver Federal Center, Denver, Colo., at \$1.00 per set.

U. S. Mines In 1949 Second Highest In History

WASHINGTON, Jan. 1 — Minerals and metals worth 13.9 billion dollars were produced in the United States in 1949, Secretary of the Interior Oscar L. Chapman announced today. Although this value was 11 percent less than in 1948, it was the second greatest in history, the Secretary stated.

The huge mineral value reflects a general continuation of high unit prices but also a mine tonnage unsurpassed in any war or prewar year, according to the analysis submitted to Secretary Chapman by James Boyd, Bureau of Mines Director.

As a group, mineral fuels decreased 12 percent in value in 1949 because of the general industrial decline, work stoppages in the coal fields, and a shift in the foreign-trade balance. Yet the volume of natural gas piped achieved an all-time high. Decreased oil output reversed a 6-year upward trend.

Nonmetallics was the only major mineral group that in 1949 equalled the 1948 production high. New records were reached by building-material producers. Demand for chemical-industry minerals subsided a little, but for fertilizer minerals remained strong.

Metals dropped 15 percent in dollar output in 1949 because of steel and smelter strikes and the break in prices of base metals. A notable exception was the increase in domestic output of lead, a metal in short supply throughout the world.

COVER PHOTO

A crew member of the Coast Guard Cutter **Evergreen** takes a last look at the last iceberg encountered by the Coast Guard's 1949 Ice Patrol. When this Ice Patrol ended they began counting icebergs from the air in their "Iceberg Census" (see page 10). Official U. S. Coast Guard Photo.

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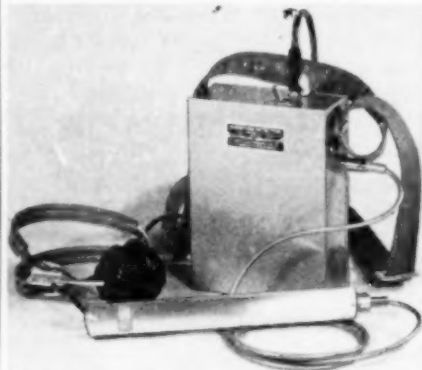
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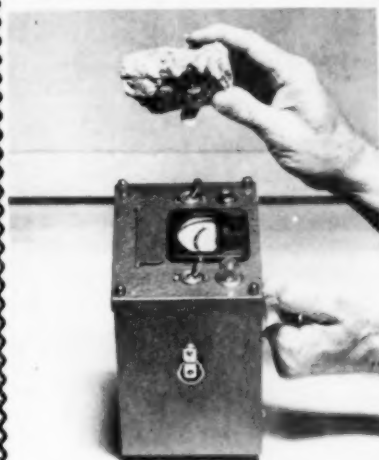
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Before me, a Notary in and for the State and county aforesaid, personally appeared Jerome M. Eisenberg, who, having been duly sworn according to law, deposes and says that he is the Editor of the Earth Science Digest and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations, to wit:

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